

boundary between the air space and the upper transparent electrodes **76** is reduced. The digital resistive contact-type touch panel **70** having high light transmittance is thus provided.

[**0096**] While each line width of the lower transparent electrodes **75** and the upper transparent electrodes **76** is on the order of micrometers, each of the projections formed on the inner surfaces of the lower substrate **71** and the upper substrate **72** or on the inner surfaces of the lower transparent electrodes **75** and the upper transparent electrodes **76** is on the order of nanometers, that is, extremely small compared to the line width of the lower transparent electrodes **75** and the upper transparent electrodes **76**.

[**0097**] It should be understood that the present invention is not limited to the resistive contact-type touch panels as described in the first to third embodiments, but is applicable to any touch panel as long as the touch panel has an air space arranged to be in contact with a transparent electrode. A touch panel having an air space arranged to be in contact with a transparent electrode may include, for example, an electrostatic capacitive coupling-type touch panel besides the resistive contact-type one.

[**0098**] The structure and the principal of position detection of the electrostatic capacitive coupling-type touch panel will now be described briefly. The structure of the electrostatic capacitive coupling-type touch panel is similar to that of the digital resistive contact-type touch panel. In the structure, stripe-like lower transparent electrodes and stripe-like upper transparent electrodes are respectively formed on the inner surfaces of a lower substrate and an upper substrate which oppose each other and between which an air space is interposed. The lower transparent electrodes and the upper transparent electrodes are arranged to cross each other.

[**0099**] Since a certain amount of capacitance is formed between the lower transparent electrodes and the upper transparent electrodes of the electrostatic capacitive coupling-type touch panel, when an operator touches the outer surface of the upper substrate with a finger, the operator's body functioning as a ground attracts electric charge, thus changing the amount of capacitance. The electrostatic capacitive coupling-type touch panel is characterized by performing position detection by measuring the amount of capacitance. While the resistive contact-type touch panel is required to input by deforming the upper substrate with a finger, a pen, or the like, the electrostatic capacitive coupling-type touch panel is capable of performing position detection without deforming the upper substrate, thereby eliminating a special pen and possibly leading to detecting a trace made by a finger or the like which moves continuously on the upper substrate.

[**0100**] The present invention is applicable to the electrostatic capacitive coupling-type touch panel as described above. As described in the first to third embodiments, the electrostatic capacitive coupling-type touch panel may have a structure in which fine projections are formed in a predetermined pattern on the inner surfaces of the lower substrate and the upper substrate, and the lower transparent electrodes and the upper transparent electrodes are respectively formed in a stripe-like configuration over the inner surfaces of the lower substrate and the upper substrate having the fine projections thereon. Alternatively, the touch panel may have a structure in which the stripe-like lower transparent elec-

trodes and the stripe-like upper transparent electrodes having fine projections with a predetermined pattern are respectively formed on the surfaces of the flat lower substrate and the flat upper substrate.

[**0101**] With this structure, the touch panel has features similar to those of the first to third embodiments. In other words, the light reflection at the boundary between the air space and the lower transparent electrodes and at the boundary between the air space and the upper transparent electrodes is reduced. The electrostatic capacitive coupling-type touch panel having high light transmittance is thus provided.

[**0102**] The present invention is further applicable to an analog electrostatic capacitive coupling-type touch panel in which a transparent conductive resistive film is coated on the entire surface of a substrate at the operator side and external electrodes for applying and detecting a voltage are provided at the four corners of the substrate. With this structure, a uniform electric field is formed by applying a voltage among the electrodes at the four corners. When a finger touches the conductive resistive film, the electric field varies by electrostatic capacitive coupling occurring at the touched position of the film. Because the current value at each corner is in proportion to the distance from the corner to the touched position, position detection is performed by measuring current values at four corners. Thus, the reflectivity at the boundary between the transparent electrode and the air space can be reduced, thereby providing a touch panel having high light transmittance.

[**0103**] The following describes a comparative example between the present invention and a touch panel of a conventional arrangement.

[**0104**] First, a substrate made of polycarbonate (PC), provided with a transparent electrode, was prepared such that a large number of fine projections were formed on one surface of the substrate and the transparent electrode made of indium tin oxide with a thickness of about 70 nm was formed over substantially the entire surface of the substrate having the large number of projections thereon.

[**0105**] Each of the projections was formed as a truncated quadrangular pyramid, having a height of 100 nm, a square bottom with a side of 100 nm, and a square top with a side of 40 nm. The projections were periodically arranged with the same pitch of 120 nm in two mutually orthogonal directions so as to be in a matrix-like configuration as a whole.

[**0106**] Next, a substrate provided with a transparent electrode was prepared in a similar fashion to the first, except that the transparent electrode was flat and formed on one of the surfaces of the flat substrate.

[**0107**] The above substrates provided with transparent electrodes prepared according to the present invention and the conventional arrangement, were then compared. The reflectivities at the surfaces of the transparent electrodes of the substrates with transparent electrodes were measured by irradiating the substrate with light having a wavelength ranging from 400 to 700 nm from the transparent electrode side. The measurements showed that the reflectivities of the substrates of the present invention and the conventional arrangement were 6 percent and 12 percent, respectively. The measurements also revealed that projections and depressions formed in a predetermined shape on the surface of the